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X17 discovery potential from $\gamma d \rightarrow e+e-pn$ with neutron tagging

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We propose a novel direct search experiment for the hypothetical X17 particle. In recent years researchers from the ATOMKI Collaboration have reported anomalous signals around 17 MeV in excited ^8Be , ^4He and ^{12}C nuclear decays via internal pair creation. On the theory side this has set off a flurry of research, which found that the anomalies could be explained by a new light (~ 17 MeV) pseudoscalar, vector or axial-vector boson, dubbed X17. To provide an independent confirmation of such particle in the production process on a nucleon, the $\gamma n \rightarrow e+e-n$ process has been proposed. Experimentally it is possible to study this reaction in quasi-free production on a deuteron, i.e., $\gamma d \rightarrow e+e-pn$, using neutron tagging, where the neutron is bound inside a deuteron. We calculate the cross section for dilepton photoproduction on a quasi-free nucleon, and optimize the kinematics for the quasi-free neutron region with the upcoming MAGIX@MESA experiment in mind. We show that the X17 signal is clearly visible above the QED background. Moreover, we show that the same measurements can be used to extract the neutron polarizabilities.

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